SAFRAN

OUR IN-HOUSE MAGAZINE
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# one

TEAM – BUSINESS – FUTURE

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## ONE BUSINESS



The Patroller drone in flight (top). Participants in the training session visit the Safran Electrical & Power plant in Morocco (bottom).



## ONE FUTURE



**Publication Director:** Pascale Dubois. Editorial Director: Marie-Laure Dufour. Editor-in-chief and project coordinator : Morgane Palacios. Written by : Jean-Pierre Alési, Alexia Attali, Kim Brown, Clémence Caillet, Caroline Coudert, Florence Clotuche, Benjamin Damge, Julie Imbert, Lori Kavanagh, Dominique Levy, Danuta Majka, Bernard Martin, Laure Monge, Élodie Pages, Diana Rozo, Emily Sung, Bénédicte Tilly, Pierre-Antony Vastra, Joëlle Wathelet. Photo: Cover: A. Paringaux/Safran. Contents: A. Paringaux/Safran, J.Kodadi/CAPA Pictures/Safran - p.3 : C. Meireis/CAPA Pictures/Safran - p.4 : L. Pascal/CAPA Pictures/Safran - p. 5 : Safran Aero Boosters/Safran, S.Kim/Safran, R. Bertrand/Safran - p.6-7 : A. Rayss/CAPA Pictures/Safran - p.8: A. Rayss/CAPA Pictures/Safran - p.9 : Freelance's l'Agence - p.10 : T. Pozniak/Safran - p.11 : The Fix Photo Group/Safran - p.12 : B. Gold/CAPA Pictures/Safran, P. Boulen /Safran, E. Drouin/Safran - p.13 : C.Sasso/CAPA Pictures/Safran, M.K. McElroy/Safran, P. Soissons/Safran - p.15 : Babel/Freelance's l'agence/Safran, P. Delapierre/Safran - p.16-17 : J. Kodadi/CAPA Pictures/Safran - p.18 : E.Drouin/Safran - p.21 : P. Stroppa/Safran - p. 22 : Freelance's l'agence/Safran - p.23 : E.Drouin/Safran - p.24 : C.Sasso/CAPA Pictures/Safran - p.25 : A. Daste/Safran - p.26 : A. Bertolus/Safran - p.28 : B. Gold/CAPA Pictures/Safran - p.29 : B. Gold/CAPA Pictures/ Safran, P. Boulen /Safran - p.30 : C. Meireis/CAPA Pictures/Safran, P.Stroppa/Safran - p. 31 : B. Vallet/Safran, D. Levy/Safran - p.32-33 : Freelance's l'agence - p.34 : The Fix Photo Group / Safran - p.35 : Pepperbox/Safran, Safran Transmission Systems/Safran - p.36-37 : Babel/Safran - p.39 : C. Sasso/CAPA Pictures/Safran, Scyther5/IstockPhoto - p.40-41 : R. Bertrand/Safran p.43 : Dixxit/Safran p.44 : Freelance's l'Agence/Safran. Design and production: Impression: Imprimerie Vincent. The articles and illustrations in this publication cannot be reproduced without prior written authorization. CFM, CFM56, LEAP and the CFM logo are registered trademarks of CFM International, the 50/50 joint company between Safran Aircraft Engines and GE.

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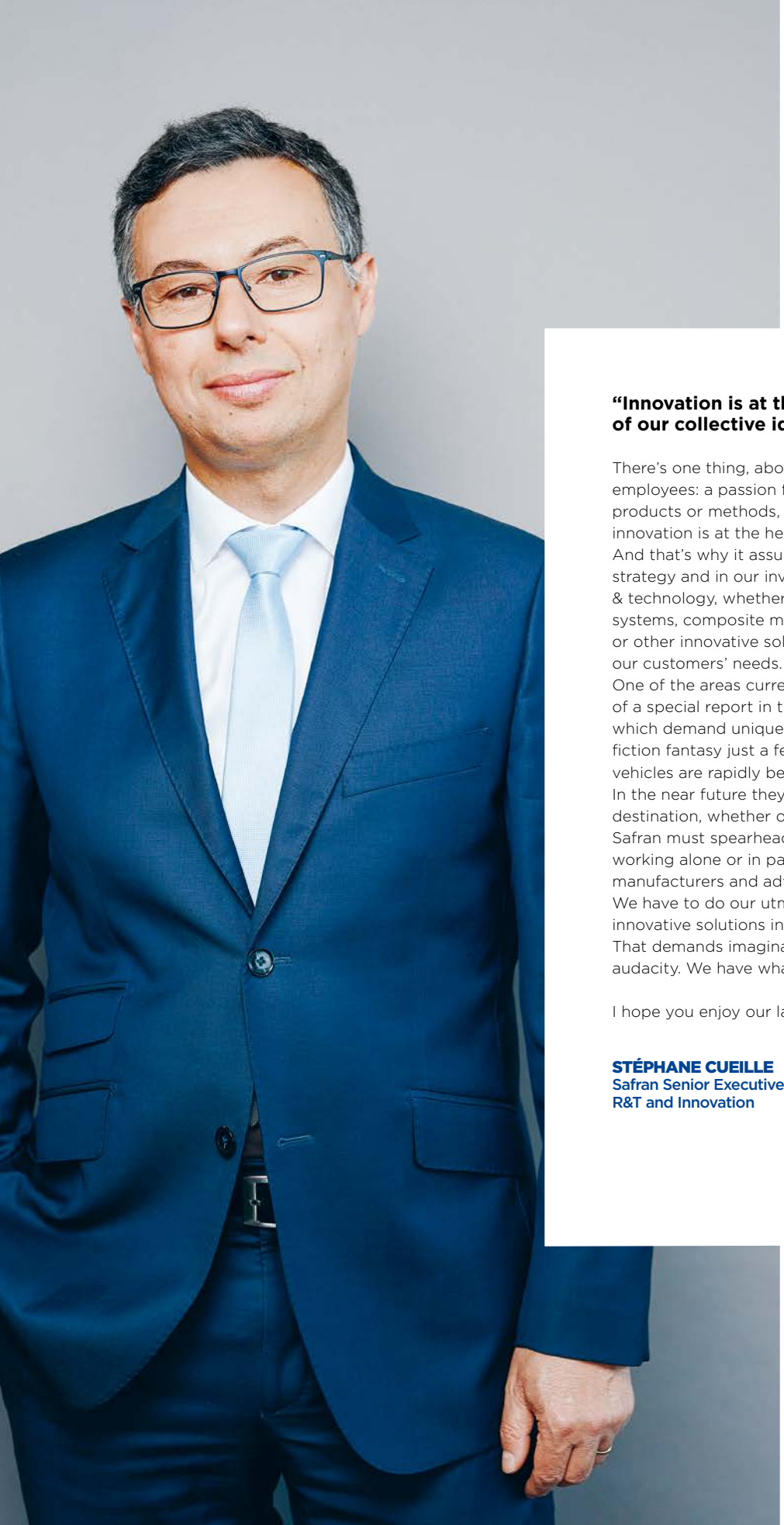


**“Innovation is at the heart of our collective identity.”**

There’s one thing, above all others, that links Safran employees: a passion for innovation. Whether for products or methods, continuous or disruptive, innovation is at the heart of our collective identity. And that’s why it assumes such a pivotal role in our strategy and in our investments. We leverage research & technology, whether new architectures, hybrid systems, composite materials, digital acceleration or other innovative solutions, to anticipate and meet our customers’ needs.
One of the areas currently under study, and the subject of a special report in this issue, is autonomous vehicles, which demand unique creativity. Strictly a science-fiction fantasy just a few short years ago, these vehicles are rapidly becoming part of our daily lives. In the near future they may be taking us to our destination, whether on land, at sea or in the air. Safran must spearhead these new mobility modes, working alone or in partnership with fellow manufacturers and advanced research centers.
We have to do our utmost to come up with innovative solutions in today’s most promising sectors. That demands imagination, expertise and, above all, audacity. We have what it takes!

I hope you enjoy our latest issue.

**STÉPHANE CUEILLE**
**Safran Senior Executive Vice President, R&T and Innovation**

# ONE TEAM

**A DYNAMIC DUO**

In 2018, Safran Aero Boosters is taking part in DUODay, a European initiative to support the hiring of disabled persons. During this day-long event, a disabled person from outside the company learns about the job performed by one of our employees. On April 26, Christelle Widart from the purchasing department showed a hearing-impaired person her daily tasks, commenting *"Since I have a hearing impairment myself, I wanted to show that this should not stop anyone from enjoying a fulfilling career."*


# AGILE

**How can we make sure our organizations are agile? The Executive Committee at Safran Electrical & Power asked nine international employees from five divisions to come up with an answer. This de facto think tank identified paths for progress and launched a project.**


**SAFRAN HELICOPTER ENGINES CELEBRATES 80TH ANNIVERSARY**

Safran Helicopter Engines has designed, produced and supported helicopter engines for 80 years now, working steadily and intensively since 1938! All of the company's facilities are celebrating this anniversary in 2018, especially on September 20, with a number of special events. Employees from all 16 facilities are celebrating by organizing activities spotlighting the company's history and entrepreneurial spirit.

# 1,400

**The new work clothes were tested in early July 2018 at 19 facilities in France, Belgium and Morocco – and they were a success! A total of 330 testers wore some 1,400 different clothing items for a week (see photo opposite). Throughout 2019, more than 200,000 Safran-branded clothing items will be distributed Group-wide.**


SAFRAN
INAUGURATION OF THE NEW SAFRAN AIRCRAFT ENGINES PLANT
JOANNA
KOSTUREK
INAUGURATION OF THE NEW SAFRAN AIRCRAFT ENGINES PLANT
JULY 4, 2019
SAFRAN
MONIKA
JAKUBEK

POLAND

# Safran to the power of 4

**Safran Aircraft Engines Poland was inaugurated on July 4 by our CEO, Philippe Petitcolin, in a ceremony attended by the Polish Vice Minister for Investment and Development, Adam Hamryszczak, the French ambassador to Poland, Pierre Lévy, and Safran Aircraft Engines CEO, Olivier Andriès.**

Sedziszow Małopolski is a city of 7,000 inhabitants in southeast Poland and home to our latest plant, Safran Aircraft Engines Poland. This new location is designed to meet a major challenge facing Safran, namely to group the manufacture of parts for the LEAP engine in a single area and support a strong ramp-up in production for this successor to the CFM56. During the inauguration ceremony, Philippe Petitcolin said: *"This new Safran facility in Poland helps us bolster the industrial ties we have formed with this country for over 15 years."*


› The 8,000-square-meter plant (86,400 sq ft), inaugurated in early July, makes low-pressure turbine blades for the LEAP turbofan engine. It already has more than 200 employees, including 150 qualified operators, who handle blade machining and surface treatment. The complexity of these parts, made of a nickel-based superalloy, demands a high degree of dimensional accuracy. The plant deploys a fleet of 20 state-of-the-art machine tools, and turned out its first blades in July 2017.
*"The operational startup was exceptional,"* recalls Olivier Andriès. *"Production engineering went especially smoothly, so we could kick off actual production in record time. The building was handed over in April 2017, and three short months later the plant delivered its first parts!"*

**A POSITIVE MINDSET**

*"The plant was designed for high-rate production, which means that our processes have to be very reliable,"* explains Ronan Carolaggi, plant general manager. *"We selected state-of-the-art machinery to handle volume production with excellent repeatability. Our aim is to achieve maximum process robustness. One major advantage of this plant is our young and well-trained group of employees, with a very positive mindset and a burning desire to learn and keep moving forward."*
*"The LEAP ramp-up allows us to ensure employment stability along with career development opportunities for our employees,"* adds Justyna Sadło from the human resources department. *"We have defined a training and development plan for supervisors. This is a very exciting challenge, and one that allows us to better understand our employees' needs."*

**"One major advantage of this plant is our young and well-trained group of employees, with a very positive mindset and a burning desire to learn and keep moving forward."**

**RONAN CAROLAGGI**
Plant General Manager, Safran Aircraft Engines Poland

Everything is now in place to meet the initial challenges of the ramp-up: a modern plant, committed people, world-class systems and processes, etc. The production of turbine blades more than quadrupled this year, and will now nearly double from 180,000 in 2018 to 350,000 in 2019, then jump to 800,000 towards 2022. Piotr Jablonski, a non-destructive testing technician, is ready to tackle this challenge, noting that *"I'm very aware of the huge upcoming workload. In fact, I'm very proud to be contributing to a program that's a landmark in the history of aviation – the LEAP is truly unique!"*

**SHARING EXPERTISE**

The new plant in Poland will also be able to share expertise with Safran's other facilities. *"During the production engineering phase, for example, we received support from the methods teams and other experts at Gennevilliers, the Group's historic casting site in France,"* explains Ronan Carologgi. *"They were dispatched here virtually every week. We also benefitted from the experience of our colleagues at Safran Transmission Systems Poland."* Justyna Sadło adds, *"On the human resources side, we held weekly meetings with our counterparts from Safran's other facilities in the region."*

**AVIATION TRADITION**

Some 90% of the Polish aviation business is concentrated in this region, dubbed Aviation Valley, and the coun-


**Philippe Petitcolin,** Chief Executive Officer of Safran, along with personnel from Safran Aircraft Engines Poland.

**Justyna Sadło,** Human Resources, Safran Aircraft Engines Poland.

## AVIATION VALLEY

Located in southeast Poland, Aviation Valley accounts for 90% of the country's aviation business. Created in 2003 by business and industry leaders, the Aviation Valley Association supports the development of the domestic aerospace industry. The region is home to a number of aerospace majors, including Safran, Pratt & Whitney, Rolls-Royce and MTU, as well as many subcontractors. Safran works with over 30 local suppliers, and has more than 1,000 employees, making it the third largest employer in Aviation Valley.

try wants to make it one of the leading aviation hubs in the world. *"At the end of the 1930s, the Polish government decided to locate its aviation industry in this region,"* says Jan Sawicki, CEO of Safran Transmission Systems Poland and Vice President of Aviation Valley. *"When a competitor bought Safran Transmission Systems' gear supplier in 2001, Safran Transmission Systems decided to buy a factory and produce its own gears. That kicked off the Aviation Valley story for us. Today, it's home to over 160 companies, with 29,000 employees."*

Safran's presence in Aviation Valley takes advantage of a number of factors, including a long aeronautical tradition, highly qualified labor and a location at the center of Europe. In fact, that's where Safran has located its four Polish facilities, thus creating its own ecosystem. After Safran Transmission Systems in 2001 came Lisi Aerospace Creuzet Polska, Aero Gearbox International and now Safran Aircraft Engines Poland.

*"Safran contributes a lot to the local community. It's the largest employer in my native city of Sedziszow Malopolski"* says Piotr. *"Safran has in fact changed the region, and for me it has become a family story. My brother and several friends all work for Safran."* The Group has also become a major player in local training schemes. Safran Transmission Systems Poland has been working for several years already with Rzeszow Technical University and its 16,000 students. At the same time, Safran is actively supporting vocational training, including curriculum modernization and making equipment available to school labs.


¹ A 50/50 joint company between Safran Transmission Systems and Rolls-Royce
² A joint-venture owned 70% by Lisi Aerospace and 30% by Safran Aircraft Engines

Safran has four facilities in Poland, all in Aviation Valley

**Mateusz Fitol,** Safran Transmission Systems Poland employee, assembling a LEAP power transmission, also called an accessory gearbox.

**“Safran contributes a lot to the local community. It’s the largest employer in my native city of Sędziszów Małopolski. Safran has changed the region.”**

**PIOTR JABŁOŃSKI,**
Non-destructive testing technician

### › SAFRAN TRANSMISSION SYSTEMS, THE PIONEER

Safran Transmission Systems was the Group’s first company to set up shop in Poland and now has over 700 employees and a factory spanning some 25,000 square meters (270,000 sq ft), specialized in the production of power transmission systems for CFM56 and LEAP engines. This type of system taps energy from the jet engines to power engine and aircraft subsystems. The plant also makes gears for Safran Helicopter Engines and components for the low-pressure compressors from Safran Aero Boosters. Production of drums, nozzle guide vanes and bearing supports accounts for 30% of the total. In addition, for several years this plant made low-pressure turbine blades, an activity now transferred to Safran Aircraft Engines’ new plant.

Safran Transmission Systems began working with other Safran companies in 2005, and this transition is clearly a success, from both the human and industrial viewpoints. With about 85% of its operations focused on LEAP towards 2020, Safran Transmission Systems Poland will assemble more than 2,000 power transmissions in 2019, 65% more than in 2017.

Furthermore, it plans to double its production of drums for Safran Aero Boosters by 2020. Given this significant increase in production volume, Safran Transmission Systems is now expanding and modernizing its plant, a process scheduled for completion in 2019. ■

# AROUND THE WORLD OF SAFRAN

Introducing a team and six individuals from Safran companies, for a quick look at their career path and vision of Safran.

## “Illuminate” Project team

Four of the nine members of the Safran Electrical & Power project team in Everett, Washington, with Ashlie Bagley, Human Resources and Project Manager.

**“The ’Illuminate’ project aims to increase the number of women managers at Safran Electrical & Power in North America. Our project team comprises men and women from different professions and facilities. We are advocates, fully aware of what women bring to the table. The project is making progress and supporting women’s career success.”**


## Steve Jenkins

Lead Test Engineer, Zodiac Seats UK

**"I lead a team that is responsible for certification and reliability testing on our seats. This includes testing of in-service issues on current products to improve reliability in design. After nearly 18 years, the job still is an enjoyable challenge."**

## Paul Ferrey

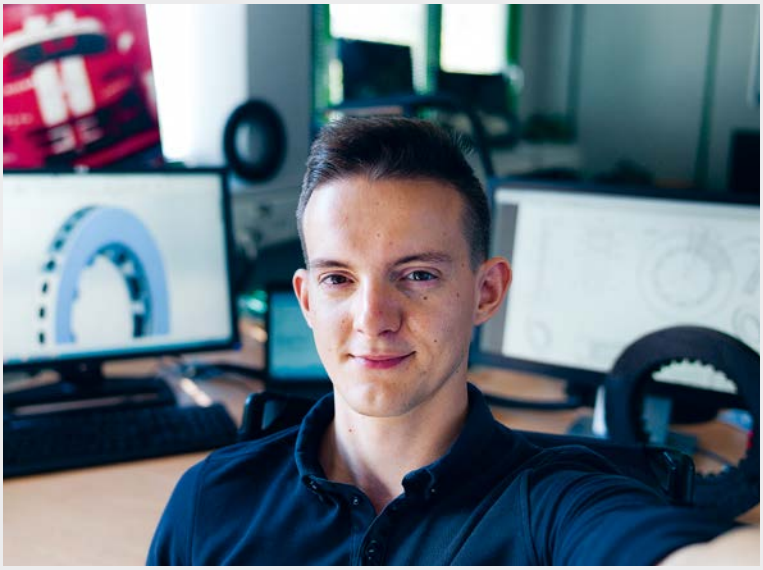
Aerodynamicist, Safran Nacelles

**"I design the shape of thrust reversers to ensure maximum aerodynamic performance. I'm involved right from the preliminary design phase, and I take part in R&D to come up with innovative nacelle concepts. It's an extremely rewarding profession, one in which I get to work with our engine and airplane manufacturer customers."**


## Charlotte Barbe

UX designer, Service Innovation Workshop, Safran Aircraft Engines

**"I help design digital services related to engine operation that are useful and functional. Capitalizing on a business opportunity, I create a digital innovation by integrating the user environment."**



## Emmanuel Rio

Auto sports operations engineer,
Safran Landing Systems

**"I work in the land braking department, which designs carbon brake disks and pads for F1 racing cars. I help teams make maximum use of our products during the races, to optimize their performance. I'm with them right on the track, 'where the action is', and that's what I like about this job."**

## Philip Ince

Engineering Test Services Manager & Design Engineer, Zodiac Aero Evacuation Systems

**"Our products save lives. The daily testing we conduct ensures that our emergency equipment operates successfully in all field conditions. This gives us all a great sense of pride in our work. Also, the wide scope of design criteria creates an exciting, unique and challenging work environment."**

## Jean-Baptiste Lefrançois

Safran International Program (SIP) – Sales

**"There are ten of us in the SIP program. We carry out three assignments over a period of two years in different companies and countries. I've been in Paris, then in Sarasota, Florida, and soon Singapore. With each new challenge I discover new activities and a culture, and I have to quickly deliver results."**

# GO SAFRAN: READY TO RISE TO THE CHALLENGE?

Do you like to play individual or team sports? Do you think physical activity goes hand-in-hand with well-being? Since June, you can register for Go Safran, the first mobile sports app for all Safran employees. Here's a quick look at this initiative and the upcoming challenges.

## HOW TO PARTICIPATE

—

Go to https://go.safran-group.com and download the Go Safran app on your smartphone (available via the App Store and Google Play).
› **Enter** your work email address and create a password.
› **Fill out** your profile.
› **Create** or join a team of no more than 12 persons.

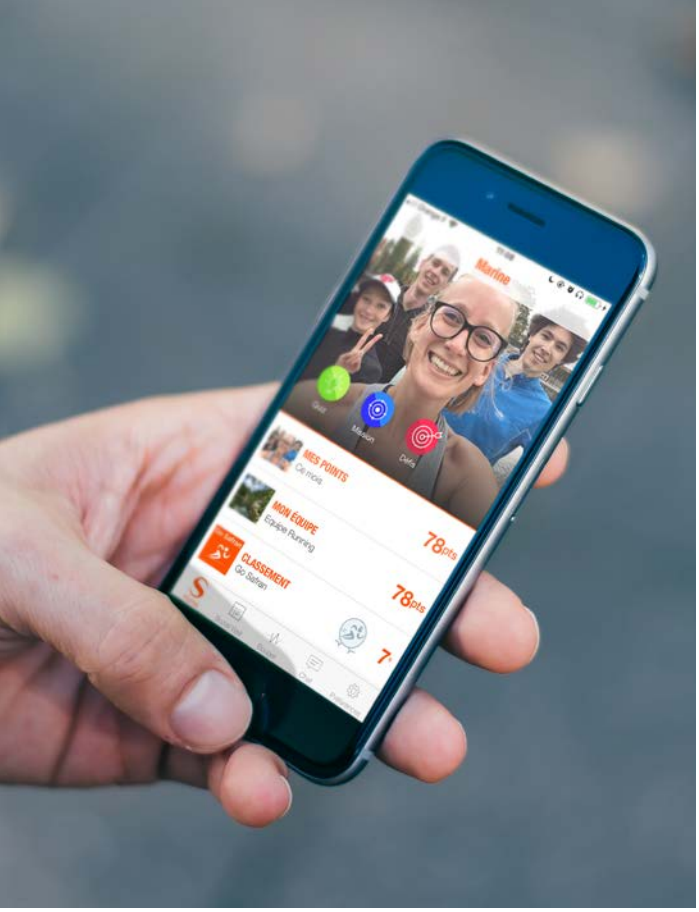
Since February 2018, Safran has had more than 91,000 employees worldwide. In June we rolled out our first Group challenge, Go Safran, a game to bring Safran and Zodiac Aerospace closer together. It is designed to unify all employees, from support to production, around collective sports challenges, and help form one Safran.

### PART OF THE INTEGRATION PROCESS

Sports is in fact the leading leisure activity in the world, and also embodies values similar to those of our enterprise. When Zodiac Aerospace became part of Safran, we naturally thought about a project of this type. It's not that easy merging two aerospace giants with a global presence and their own culture. Hélène Moreau-Leroy, head of the Zodiac Aerospace integration, emphasizes that *"People are really at the heart of this project."* A sports-oriented project like Go Safran helps create a shared culture and fosters the integration of all employees. That's one of the aims of the integration project, as Moreau-Leroy explains: *"We want all employees to be proud of belonging to Safran. This integration initiative will also help standardize our working methods across all business lines, and foster their recognition as best-in-class by our customers, to maintain leadership in our markets. We can only meet these objectives as a team, and that's exactly the value embodied by our new Go Safran sports project."*

### SAFRAN'S FIRST SPORTS APP

Go Safran is actually very simple: you download the app and join or form a team. It records and analyzes your physical activity as you walk, run or ride a bike. Each activity earns points. As a team, you try to meet the objectives set in different challenges. Alone you can go faster, but together, you can go further. Pascale Dubois, Safran's Executive Vice President for Communications, reiterates the advantages: *"At Safran, teamwork is essential, and sports helps us stay in shape. We realized that combining these two notions would be a critical part of the integration process."*




**The Go Safran app** allows you to create or join a team, take part in quizzes and missions, and track your athletic performance.

**COME AS YOU ARE**

Whether walker, runner or cyclist, beginner or experienced, Go Safran is designed for all of us! Through this app, employees create ties with colleagues they might not have had the opportunity of meeting otherwise, discover other job families in the Group, and get motivated by supporting each other. Mixed teams of Safran and Zodiac Aerospace personnel also get an extra boost to win even more points. For seasoned athletes among our employees, the Go Safran app is also connected to existing running and hiking apps, such as Endomondo, Runtastic, Garmin, etc. Beginners will be able to win points by answering quizzes on Safran's businesses, or on health. After a first successful challenge between Paris and Farnborough in early July, new challenges await us in the autumn. Winners of each challenge can win medals bearing the name of materials used in Safran products. Will your team win the Composites medal and take its place on the top step of the podium? ■

**ALBAN MORZYGLOD**

**Cabin program manager, Zodiac Aerospace**

I always liked sports and have played competitive volleyball for a number of years. But there was a big gap between that and running every day! It all started with a bet between colleagues, who entered me in a Paris-Versailles race for September. I only had a few months to get ready. Fortunately, the Go Safran challenge was launched at the same time. The day it started, I joined the OPFever team, comprising equally athletic members and led by a highly motivated captain. Since early June, we've been very motivated to run together at the Plaisir facility, near Paris, France, twice a week. We're competitive, but there's also a real team spirit.
In short, I'd say that sports has two main advantages: it unites employees and also decreases our stress because we take care of ourselves.

MOROCCO

# Rachida ELATBANI

**Wiring trainer, Safran Electrical & Power**

Rachida has been working at Safran Electrical & Power in Rabat for 19 years. Since 2005 she has trained employees in wiring techniques, mostly women because these jobs demand dexterity. She transmits her knowledge with generosity and understanding.

I welcome new wiring "students"; there are about 40 for each session. First, they go to the infirmary, then to the Human Resources department. The training takes three to five weeks, depending on the specific job.

**8:00 AM**

I take them on a guided tour of the plant, so they see what we do and I show them the products they'll be working on: electrical cabinets, wiring harnesses for fuselages and engines, etc. They discover their future workplace and meet current employees for the first time.

**9:30 AM**

We get to the classroom, where I present all the processes involved in their new jobs.

**11:00 AM**

**1:30 PM**

Classroom work starts. I describe the fundamentals of Safran's culture, including quality control and health, safety and environment (HSE).

## 240,000

—

**Rachida has provided 240,000 student-hours of training in five years,** including classroom work, reviewing all instructions, basic technical skills (insertion, shielding, crimping) and specific requirements for new programs. At the end, all participants take a test on a computer, and their objective is to get 80% right!

**3:00 PM**

**5:00 PM**

**Left**: My assistant and I provide additional practical training for employees returning from long leaves or for new products.
**Above**: I meet with the quality teams and we identify requirements in terms of raising awareness in the case of recurring defects and also how to improve training courses.

# ONE BUSINESS

# LEAP

**1.5 MILLION HOURS AND COUNTING!**
The new LEAP engine, powerplant of the Airbus A320neo and the Boeing 737 MAX, passed the milestone of 1.5 million flight-hours early this summer. More than 700 engines had been delivered at that date to some 60 airlines from around the world.

# 2,000

Two thousand Safran Nacelles thrust reversers have been delivered from Burnley in England to Honeywell for all versions of the HTF7000 engine. This new powerplant has already been chosen for several business jets: Bombardier Challenger 300/350, Embraer Legacy 450/500, Gulfstream G280 and Textron Cessna Citation Longitude. The assembly process uses a stepping line, which handles different versions of the product, without any quality defects.

# APPROVAL

In 2017, Safran Engineering Services earned Design Organization Approval (DOA) 21J.611, enabling it to certify modifications on behalf of the European Aviation Safety Agency (EASA).

# BOOSTER

**A STORY OF MEN AND MACHINES**
Safran Aero Boosters has been working on a booster (low-pressure compressor) operating at twice the speed of current versions since 2012, as part of the European project ENOVAL. The booster is now under test at the Central Institute for Aviation Motors (CIAM) in Russia, with a target service entry date as from 2030.

## ENTERTAINING CHINA SOUTHERN PASSENGERS

Zodiac Inflight Innovations has been awarded a contract to outfit twenty China Southern Airbus A350 widebody twins, to be delivered from June 2019. This Business Unit will deliver RAVE passenger screens for economy, premium economy and business class. China Southern will be one of the first airlines to benefit from the newly designed graphical user interface. China Southern also chose to offers its passengers in-flight connectivity.

INTEGRATION

# Vincent MASCRÉ

**Chief Executive Officer of Zodiac Aerospace**

## "Our initial results are encouraging. But we need to act faster. There's still an awful lot of work to be done!"

**Since being appointed, what top priorities are you addressing?**

**V.M.:** The top priority was to improve, or restore relations with our customers. At the Aircraft Interiors trade show last April in Hamburg, I met the heads of a number of airlines, and they all told me: *"We need Zodiac Aerospace."* But they also emphasized that Zodiac Aerospace has to be a trusted, reliable and effective partner, capable of developing and delivering the products they need to improve the passenger experience and stand out in a highly competitive market. Our second objective is therefore to improve our operational performance, which is in fact a key to improving our customer relations. We have already seen very promising and significant initial results, for example on the lavatories for the Airbus A350XB. Our third priority is to invest in the future. We have to renew our product portfolio and offer our customers innovative solutions with a distinctive difference. For instance, our in-flight entertainment and connectivity solution, RAVE, has pushed Zodiac Aerospace to No. 3 worldwide in this segment, and given us a bright business outlook. Likewise, the concept of configuring modular rest areas in the cargo deck has awakened keen interest from airlines and the media. Zodiac Aerospace has to keep moving in this direction and invest more heavily in developing the technology building blocks needed to create new products.

**How would you describe the situation when you came to Zodiac Aerospace?**

**V.M.:** First, I met men and women who are very proud of their company and its products, and who are very open-minded, responsive and creative. I also saw a company whose operations were still too makeshift, and not entirely up to industry standards, affecting all aspects from development to production to support. This type of organization, typical of a grouping of small companies, was holding back the development of a major equipment-maker the size of Zodiac Aerospace. A scattered organization like this could result in insufficiently robust processes and a lack of rigor in applying them. In addition to costing the company a lot of money, the crisis also sometimes led to behaviors entailing an urgent search for short-term solutions, while penalizing in-depth solutions.

**How is the integration proceeding these days?**

**V.M.:** We've gotten to the heart of the subject. Three major projects were launched in May, targeting operational implementation in November: the merger-absorption of Zodiac

**"The top priority was to improve, or restore relations with our customers."**

**“In Hamburg, the heads of a number of airlines told me: We need Zodiac Aerospace.”**

Aerospace S.A. by Safran S.A., the name change and the organization in three companies including support services: Safran Seats, Safran Cabin and Safran Aerosystems. We are continuing to deploy One Safran and Lean-Sigma tools and methodologies, and have already generated good results. After receiving support from Safran’s experts at Zodiac, we are continuing to train Green Belts and Black Belts. We have also set up mobility paths within the Group: Zodiac Aerospace employees have transferred to Safran and vice versa, contributing to the mutual enrichment of the entities concerned.

**How are you able to manage both Zodiac Aerospace and Zodiac Seats?**

**V.M.:** It’s a temporary situation. There’s a lot of pressure on my own time, of course, but I’m aided by teams of brilliant people, fully committed to developing, supporting and deploying these projects. By working as a team, we can multiply the impact of our actions.

**Do you have a message for Zodiac Aerospace employees?**

**V.M.:** I think it’s worth emphasizing that, even if some of our customers had harsh words for us, they were also encouraging. Our customers say that they need us. I would also like to sincerely thank all employees who stepped up to the plate to carry out urgent recovery actions: initial results are encouraging. But we need to act faster and deploy these necessary improvement actions. There’s still a lot of work to be done and tackling this task promises to be very exciting! ■

**“I’m surrounded by brilliant people, fully committed to developing, supporting and deploying our projects as a team.”**

# FROM MADE IN FRANCE TO MAKE IN INDIA, THE RAFALE STORY

**After a quiet start, Rafale export sales took off in 2015. We take a look back at the story of Rafale fighters, now an international saga, in which Safran plays a major role.**

**Safran's** contribution to the Rafale.


The Rafale "omnirole" fighter made its first flight on July 4, 1986 from the Istres air force base in southern France. Capable of performing all missions assigned to France's fighter force, this technological jewel is fitted with a number of systems and equipment from Safran, a legacy partner of planemaker Dassault Aviation. However, in the early 2000s, orders were stuck at 132 Rafales for the French air force, and 48 Rafale M models for the French navy. As the world's geopolitical situation evolved, things would change...

## GLOBAL SUCCESS

France deployed its Rafales in 2007 in Afghanistan, then in Libya for Operation Harmattan in 2011, greatly impressing observers, followed by missions in Mali and Iraq. These foreign deployments would unlock the door to export sales. In February 2015 Egypt ordered 24 Rafales, followed by Qatar, which also ordered 24. India finally


**February 14, 2018:** Two Rafales from the Saint-Dizier air force base fly over Safran Aircraft Engine' Villaroche plant to thank its employees.

made up its mind in 2016, placing an order for 36. The next year Qatar converted an option for 12 additional planes. To date, 96 Rafales have been sold in export markets, equal to more than half of the 180 aircraft ordered by France. These business wins obviously have a very positive impact on the Rafale consortium comprising Dassault Aviation, Thales, Safran Aircraft Engines and their own suppliers.

Back in February 2018, during the inauguration of the two new M88 production lines at Safran Aircraft Engines, two Rafales flew over the Villaroche site to thank everybody involved. Jean-Marc Gasparini, a former pilot who's now Executive Vice President, Military and Space Programs at Dassault Aviation, shared his enthusiasm with everybody at the ceremony, commenting, *"We now have a very healthy order backlog. The export battle is also fought and won on Safran's production lines."*

Safran Aircraft Engines M88 program director Eric Portejoie added: *"We're deploying a full range of support resources for our export customers, including publications, training and three local tech reps. Safran was also very involved in the creation of a maintenance shop at the Berigat air force base in Egypt. Over and above the symbolic importance of this first contract with Egypt, which will have taken delivery of 23 of the 24 aircraft ordered by the end of 2018, it's also a complete success in terms of production and customer satisfaction. Qatar is expected to introduce the Rafale into its fleet in early 2019, followed by India."* However, the Indian contract is rather complicated, because New Delhi is requesting various offset agreements, still being negotiated.

## UPGRADES IN VIEW

Other Safran companies involved in the Rafale are working very actively on the program. Safran Electrical & Power plans to make some wiring for the Rafale in a new plant in Hyderabad, within the scope of the Indian government's Make in India initiative. Current prospects for Rafale sales include Malaysia, Finland, Belgium and Switzerland. Meanwhile, partners in the Rafale consortium and French defense procurement agency DGA are gearing up for an improved version of the aircraft. The Rafale F4 standard will make its entry in 2024, ensuring the aircraft's production for several more decades. *"Thanks to its major manufacturers, France offers nose to tail expertise in the production of combat aircraft,"* notes Olivier Andriès, CEO of Safran Aircraft Engines. *"As a partner in the Rafale team, Safran – the only complete military engine manufacturer in Europe – rises to the challenge of ensuring national sovereignty."* ■

# MASSY CELEBRATES 70 YEARS OF WINNING

FELIN soldier modernization suites, helicopter autopilots, flight data recorders, optronic attack masts… The Safran Electronics & Defense plant in Massy, near Paris, is a pioneer in many fields. It celebrated its 70th anniversary on June 4, 2018 in a ceremony spotlighting the power of teamwork and innovation.

*"Our past shapes what we are today."* That's how Martin Sion, CEO of Safran Electronics & Defense, started his keynote address in front of the 400 guests who had been invited to celebrate the 70th anniversary of the Massy plant, located in the Essonne department about 20 kilometers south of Paris. Over these seven decades Massy has developed a number of innovations and scored many business wins, to foster local economic prosperity and build solid technology foundations. The Essonne prefect, Jean-Benoît Albertini, was also a guest. He paid tribute to the long-standing links between Safran and the Essonne, characterized by *"excellence, gradual consolidation, know-how and shared intelligence."* These bonds have been further cemented by the plant's proximity to prestigious French engineering schools, including ParisTech and Polytechnique. Two plant employees, Catherine and Marvin, also emphasized the power of teamwork, as they evoked *"70 years of a team spirit, transmitting knowledge, research and progress."*

## FROM TESTS TO SUCCESS

It all started in the late 1940s with the nearby Brétigny flight test center, which needed instruments for its tests. SFIM (Société de fabrication d'instruments de mesure), which would later become Sagem, then Safran Electronics & Defense, supplied these instruments. Carrying on this long tradition, Safran's current offering includes a complete range of flight data recording devices, along with a data management service, Cassiopée. These efforts have been so successful that Safran now collects and analyzes flight data for one out of every three commercial airplanes in the world!

## DIVERSIFICATION

The Massy-based company began to diversify its business portfolio in the 1960s. It designed an autopilot for heli-


**Massy employees** during the 70th anniversary celebration.

**"Thanks to all of you, Massy is now blazing a trail for other successes. We have to cultivate the spirit of innovation that has characterized Massy for 70 years."**

**MARTIN SION**
Chief Executive Officer of Safran Electronics & Defense

## SAFRAN IN MASSY

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**The Safran Electronics & Defense plant in Massy houses some 2,000 employees. Since 2014, Massy has also been home to the Safran Campus and University, which provides training to 10,000 employees a year.**

**Today, soldiers count on FELIN and JIM Compact,** tomorrow perhaps exoskeletons and robots... Massy is a pivotal player in shaping the future of dismounted combat.

copters, quickly chosen by Aerospatiale (now Airbus Helicopters) for the Ecureuil, Dauphin, Super Puma and other rotorcraft. This business line would keep growing and Safran is now the world's leading producer of autopilots for helicopters.

Also back in the sixties, Massy developed stabilized infrared sights for both tanks and helicopters. Night vision became possible, with a stable field-of-view despite the vehicle's movements. Today, with successful products such as the Euroflir™ 410 and the Paseo sight, Safran has bolstered its European leadership in observation, reconnaissance and identification systems for helicopters, ships, armored vehicles and drones. Plus, thanks to the increasing miniaturization of electronics, infantry soldiers can also benefit from night vision, using "optronic" (electro-optical) equipment. The original JIM infrared binoculars, developed towards 2000, have gone from success to success over the last two decades. Safran also outfits some 20,000 French soldiers with FELIN, its integrated equipment suite for modern warfighters.

In 2010, Massy consolidated the Group's electronic control unit business, especially with FADEC (full authority digital engine control) systems for the CFM56, LEAP, M88 and other engines. Safran is now one of the world leaders in this market segment, a position that will be further strengthened in 2018 by the FADEC Alliance with BAE Systems and GE.

### LOOKING TO THE FUTURE

To make sure that Safran retains its market leadership in all these fields, Massy is investing in a stream of innovative technologies that will reshape tomorrow's combat environment. Sci-Fi like exoskeletons, for instance, will give warfighters a significant edge on the battlefield by multiplying their strength and endurance. Massy is also where Safran is developing eRider, an autonomous vehicle demonstrator that heralds tomorrow's collaborative combat, in which soldiers are backed up by robots. Between innovation, agility and a winning mindset, Massy continues to express its pioneering spirit. ■

# THE H160, AN OMNIROLE HELICOPTER

Emotions were at a fever pitch on February 9, 2018 at the Safran Helicopter Engines plant in Bordes, southwest France. The latest member of the Airbus Helicopters family, the Arrano-powered H160, is about to land on the esplanade in front of the plant – a first! We take a closer look at this unique moment, and Safran's contribution to this helicopter.


**The H160** at Safran Helicopter Engines' Joseph Szydlowski plant in Bordes, southwest France, on February 9, 2018.

## H160 MILESTONES

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**March 2015:** H160 program launched at HAI Heli-Expo.

**January 27, 2016:** First flight of the Arrano-powered H160.

**March 2017:** Selected by the French Ministry of Defense for the HIL program.

**March 2018:** First order, from British company Babcock.

**2019:** Entry into service.

*"The landing in front of the plant by the H160, powered by our brand-new Arrano engine, is a highly symbolic moment, charged with meaning for everybody who worked so hard on the engine. The H160 is also the launch customer for the Arrano,"* explains Cyrille Ressejac-Duparc, director of the Arrano program. Pilots and test engineers from Airbus landed the machine on the esplanade in front of the Safran Helicopter Engines plant on February 9, 2018 at 9 a.m. After the Airbus team visited the workshops, they gave a presentation on the H160 flight tests to over 300 employees. *"In the beginning, we simply wanted to bring Airbus pilots to Bordes so they could talk with our people"* says Yann Frejaville, head of marketing at Safran Helicopter Engines and coordinator of the day's events. *"But because they had the H160 with them in Pau for a special French army event, they were able to fly it to Bordes. It was an opportunity not to be missed!"*

**OMNIROLE**

The H160 is Airbus Helicopters' new flagship in the 6-ton class. It's a real "omnirole" machine, designed to handle a wide range of missions, including VIP transport, search & rescue and offshore transport. It will enter service in 2019.

Initially intended for civilian operators, the H160 will later be militarized to replace the light and medium helicopters now deployed by French armed forces, as part of the light joint-services helicopter program (HIL). The H160 already incorporates a number of innovative technologies, such as electric braking – the first helicopter in the world with this type of system – and carbon composite brakes.

**POWERED BY SAFRAN**

With the Arrano's selection, Safran Helicopter Engines bolsters its position in this fiercely competitive market. Slated for certification at the end of 2018, the Arrano will become the benchmark in its class, developing some 1,300 shaft horsepower (SHP). Pilots are very impressed by the H160's exceptional handling characteristics, especially lightning acceleration. Combining performance, a simple design and easy maintenance, the Arrano is also fuel-efficient, consuming 10 to 15% less than engines in its class now in service.

**EQUIPPED BY SAFRAN**

Safran is a major contributor to this new helicopter, with a wide range of equipment that shows the complementary packages we can offer customers. Safran Electrical & Power, Safran Landing Systems, Safran Electronics & Defense and Zodiac Aerospace all make innovative contributions to the H160, including electric brakes and wiring harnesses, electrified cockpit components, flight control actuators, attitude and heading reference system, fuel tanks and supply system, electrical distribution systems and even rafts! The new Airbus helicopter provides a striking example of how Safran companies can team up on a single program. ■

# ONE SAFRAN, A SUCCESS AT BURNLEY

Safran Nacelles' Burnley plant in the U.K. is a model of employee engagement, with nearly a dozen One Safran projects completed across all departments and 11 others under way in the span of 18 months. The results of these efforts can already be seen, and everybody is celebrating!


Jackie Taylor, head of continuous improvement and risk management at Safran Nacelles in Burnley, and Marie-Elodie Sellier, continuous improvement manager in the industrial department, talked with Safran's Quality and Continuous Improvement department in early 2017. *"They asked us to take a look at the Production handbook to see if it was possible to launch a pilot project at Burnley,"* explains Jackie. *"At first, we found this document a bit complex, but we quickly understood that it would help our teams resolve lingering problems."* A pilot project was launched in the spring of 2017 on the Airbus A320neo assembly line – a key program for this British facility.

**TOTAL COMMITMENT**

Meetings were subsequently organized to explain the project and processes in greater detail to the people involved. Everybody had to be fully mobilized to make sure this 12-week pilot project was a success with both operators and management. According to Jackie, *"The personal investment of the people involved showed that real teamwork can quickly make a big difference."* One Safran projects were then launched in other areas: composite layup, painting, welding. As for other projects, the recommended timetable functioned to perfection: self-assessment of maturity, selection of priority standards, development and application of a road map, final self-assessment and, of course, a celebration at the end! Each participant receives a certificate during this celebration, from a member of the management committee, or even from company CEO Cédric Goubet for the paint workshop team.

**A NEW CHAPTER**

Eleven projects are now under way. The A320neo nacelle assembly line is being reviewed after several months, as suggested by the One Safran project, and a pilot project on supply chain management will kick off by the end of 2018. Results have been excellent to date, concerning both performance and the work environment. *"We have implemented a number of initiatives, including a complete revamp of our workstations,"* says Jackie with a smile. ■

**"The personal investment of the people involved showed that real teamwork can quickly make a major difference."**


**Regular meetings at Safran Nacelles' Burnley** plant focus on the One Safran standard, "Total Productive Maintenance".

**AARON TIGHE**
**Production engineer, paint shop, Safran Nacelles Burnley**

"When I heard about One Safran for the first time I was a bit worried. But after the success of the A320neo nacelle assembly line pilot project we suggested that the team launch our own improvement project. They quickly embraced the idea. We wanted to decide ourselves about the improvements needed in the workplace. On the day we celebrated the end of the project Cédric Goubet and other corporate officers were there to congratulate us. We were both proud and delighted to show them our work. Today, our team is stronger and more efficient. To take just one example, we reduced the time needed to fill out the log sheets from four hours to forty-five minutes! That's the equivalent of saving 32 weeks of work a year."


**Above:** Staff involved in this project celebrate the performance improvements after just 12 weeks.
**Left:** A visual management approach is used during project progress meetings to facilitate information sharing within the team.

# QRQC: FROM SHOP FLOOR TO OFFICES

The concept known as QRQC – Quick Response Quality Control – is often associated with production, but it's just as effective in offices. Designed to resolve anomalies quickly and locally, it's also a management method, turning managers into leaders. We take a closer look at five initiatives across Safran.

**ARNAUD GREFFET**

**Director of Safran Finance Services**

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"We launched the QRQC initiative at Safran Finance Service in the summer of 2017. I deployed this concept based on two observations: to have standardized, "industrialized" processes; and a need to sustainably improve our daily performance. But we faced a number of challenges. Unlike QRQC in production, our products and processes are immaterial, although the method used is similar. We implemented it in stages. First, we shared our vision and objectives with the team, then we earned their buy-in, thanks to training and effective change management. At that point, QRQC became an integral part of our service culture. Our accounting quality, process efficiency and customer service all improved as well. I have a few tips for anyone deploying QRQC: talk with your team, ask for support from the Lean and Quality networks, and stay on course. You're all welcome to come see what we've done." ■

**ALAIN FREHRING**

**Vice President for Purchasing, Safran Landing Systems**

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"Starting more than two years ago, QRQC is one of our channels for improving supplier performance. In fact, it's a very ambitious approach spanning management and corporate culture. We therefore have to deal with suppliers who have embraced this initiative and are ready to change. One of our first projects, just completed, concerned a supplier of complex shock strut parts. They were not improving their operational performance and regularly had quality defects. Since we set up QRQC, their non-compliance rate has plummeted. The project's success was largely due to the supplier's commitment, since they realized how the approach could help them, by improving responsiveness, providing greater customer focus and of course enhancing their performance. The deployment of QRQC is continuing at other suppliers." ■

## INSPIRING OTHERS

Safran Nacelles has opted for a "viral" deployment because QRQC is not just a methodology but a state of mind. Since 2015, for instance, managers who want to take the plunge are seconded by coaches to develop their QRQC project. And their success inspires others to follow them. The upshot is that nearly all support functions have launched at least one pilot project.

**AMEL VERA**
**Product support engineer, Safran Transmission Systems**

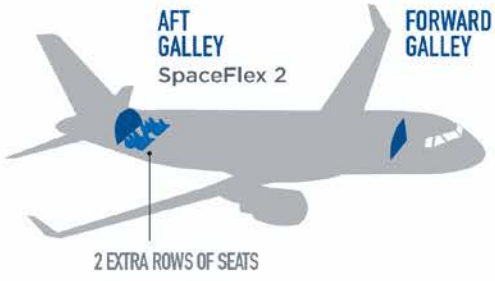
"Our aftersales support department implemented QRQC a year ago to measure and improve its productivity. We have focused our efforts on managing Customer Support Center (CSC) cases for the CFM56. As soon as we receive a part to be repaired or overhauled, our MRO (maintenance, repair, overhaul) department inspects it. If they detect an anomaly, they issue a report, which is sent to Safran Aircraft Engines' CSC, which opens a case. QRQC enables us to manage the department's workload, provide timely answers to customer questions, identify and address any problems immediately, and measure operational efficiency. Results are very encouraging, including a 90% on-time response rate, a better overall view of our performance and quicker handling of CSC cases. Our next step is to make sure the LEAP ramp-up is a success!" ■

**JEAN-YVES RIOU**
**Vice President, Mechanical Engineering, Safran Electronics & Defense**

"QRQC has been deployed across the Engineering department, which designs our products, for the last year. It's a great time-saver for team management. I have replaced our long weekly meetings with a daily QRQC meeting that lasts only 45 minutes on average. We focus on technical issues, and I try to find an organizational solution immediately, through direct contacts. More than half of all problems are solved during the session, and a quarter during the day. QRQC is also a great team-building tool. A mutual assistance network has been created and I circulate information that sheds light on each person's activities. QRQC has become a daily management tool." ■

# GALLEYS, COMFORT IN A NUTSHELL

Zodiac Aerospace has offered the SpaceFlex 2 galley for the Airbus A320 since 2014. This compact airborne kitchen offers an optimized layout, and even integrates two lavatories on the right-hand side. In turn, this frees up space to put in two more rows of seats to boost the airline's revenues.




## STORAGE BOXES

Used to store food or utensils, and using the entire galley volume.

Up to 19 storage boxes in a galley.

## GALLEY INSERTS

Ovens, coffee machines... Airlines adopt these "inserts" to their service style, to provide hot meals, beverages and snacks.

A galley oven can reheat up to 48 meals at a time.

## TROLLEYS

The galley can hold up to eight half-trolleys, refrigerated or not, containing either food and beverages or products for sale.

Temperature maintenance solution.

## ATTENDANT SEATS
Mounted on the toilet doors, and used by flight attendants during taxiing, takeoffs and landings, giving them a direct view of the entire cabin.

## LAVATORY CABINETS
Optimized for short and medium-haul routes, these lavatories feature a modular design for maximum space efficiency.

## BUSINESS SUCCESS

**41** AIRLINES ALREADY CUSTOMERS

**500+** UNITS IN SERVICE

## TRANSFER SEAT FOR THE DISABLED
With the transfer seat, lavatories are more accessible to persons with limited mobility.

## WATER AND WASTE SYSTEM
The lavatory system has been revamped to reduce weight, but above all to drastically cut maintenance time and cost.

33% less water per flush.

# ONE FUTURE

## Electric taxiing program launched

Airbus and Safran Landing Systems approved the official launch of the electric taxiing development program for the A320 family. Tests are slated to start in the first quarter of 2019.

## ARTIFICIAL INTELLIGENCE

**PARIS-SACLAY**

**Since 2016 a multi-company task force in the Paris-Saclay industry and research cluster has proposed workshops concerning machine learning and deep learning.** If you're into artificial intelligence, you can take part in these Safran Tech-led workshops by registering via the dedicated collaborative network.

**MODULAR HONEYCOMB MAT**

Winner of the Field Innovation award at the 2018 Safran Innovation Awards, the modular honeycomb mat was developed by Safran Transmission Systems to handle cylindrical parts on a flat surface, without damage or drops. This simple yet innovative system, now patented, could well be deployed to handle other parts at Safran.

**SAFRAN ELECTRICAL & POWER CREATES FIRST RESEARCH AND CERTIFICATION LAB IN THE UNITED STATES**

On June 21, 2018, Safran Electrical & Power inaugurated its first laboratory in North America, in Everett, Washington, near Seattle. It was founded to support technological developments and increase value-added for customers, especially Boeing. In addition to its research mission, the facility will offer new services to the planemaker, which has a strong presence in the Seattle area and can request component test and certification services.

Zodiac Aerospace is gearing up for its first generation of connected seats. The objectives for a rollout in 2021 include predictive maintenance, greater passenger comfort and faster cabin preparation, giving the flight crew the info needed to check that seats are in the right position for taxi, takeoff and landing (TTL).

# WILL THERE BE A PILOT IN THE PLANE?

From the Internet of Things to cars fitted with automatic emergency braking, the objects we use on a daily basis are becoming more and more automated. The aerospace sector was in fact a pioneer in this trend, with autopilots and drones appearing many years ago. And it may soon bring this capability to a whole new level... We take stock of a rapidly evolving market and technologies.

**First flight of the Patroller drone configured for the French army.**

## MISSION AUTONOMY

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**For maritime surveillance missions, the Patroller drone is capable of automatically classifying boats located in a zone specified by the operator. Observation reports are generated automatically, ensuring that the operator won't miss any points of interest, and can focus on priority targets.**

July 11, 2018: the Patroller drone makes its first flight in a configuration developed for the French army. This new multisensor drone is designed for surveillance and intelligence missions. Drawing on 25 years of experience with tactical drones, Safran Electronics & Defense has been developing this new system since 2009. In 2016, the Patroller won a competitive bidding war with its selection by the French defense ministry as the French army's new tactical drone system. The following year, it won the FURIOUS contract, a program to develop autonomous vehicle, drone and robot demonstrators for testing by French armed forces. The automation revolution is underway!

### SMOOTHER CIRCULATION

Given the jump in urban road traffic, the fast-paced growth in air traffic and a focus on developing greener mobility modes, we now have to implement solutions that improve transport safety, reduce costs and address new uses. By automating vehicles we can optimize their trajectories, reduce fuel consumption and relieve drivers and pilots from certain repetitive tasks. The Patroller, for instance, will be fitted with a see & avoid system to detect any collision risks and take avoidance actions, without requiring commands from a ground operator.

Patrick Durieux, head of sales & marketing in the Safran Electronics & Defense Drones department, explains: *"The aim at this point is not for the drone to make its own decisions about its mission, but rather to help the operator and enhance mission efficiency."* While cars, planes and drones operate in different environments, the underlying autonomy technologies are the same.

### REACTING TO THE ENVIRONMENT

There are three main types of challenges we face in this area: see and understand the environment, navigate and interpret. Automation requires growing expertise in the endless possibilities offered by artificial intelligence. When it comes to driving, each trip is unique, between the actual trajectory, state of the road, the weather, traffic and pedestrian behavior. Just the "park assist" function offered by the latest cars requires developers to integrate a million different scenarios. We have to develop software capable of continuous learning and adapting behavior to their environment. *"It's still a relatively new subject for us. Safran is seeking to develop its expertise in this area, especially through partnerships with academia and by attracting new talent,"* says Nicolas Fouquet, head of the autonomous vehicles lab formed in partnership between PSA, Valeo and our R&T center, Safran Tech.

### ALONE AT THE CONTROLS

All of these technologies have driven the emergence of the first civilian applications. Safran Engineering Services, in conjunction with Safran Electronics & Defense, is working with automaker PSA (Peugeot-Citroën) by

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contributing their expertise in system engineering, data fusion, operating safety and certification. The aim is to start the production of semi-autonomous vehicles as early as 2020, allowing drivers to take their hands off the wheel at certain moments.

Aircraft manufacturers are also looking into these technologies. Air traffic is growing so fast that a pilot shortage is expected. But a sufficiently autonomous plane only needs a single pilot. That's the objective of Airbus' Single Pilot Operation project. The technologies developed through this project could support the construction of completely autonomous planes. "Autonomous passenger planes will not be flying tomorrow," admits Thierry Dupoux, head of Research & Innovation at Safran Electronics & Defense. "But the initiative is under way. We're working to develop our competencies in this area, and to carve out a spot in the ecosystem now taking shape."

## AUTONOMOUS VEHICLES ON THE ROAD

The first autonomous vehicle demonstrators are already starting to prove their mettle. For instance, Safran Electronics & Defense is developing the eRider all-terrain vehicle in partnership with small French companies and labs. Capable of operating in partial or total autonomy, it will be tested under real conditions as part of an infantry platoon in the French army. Having access to an autonomous vehicle allows soldiers to concentrate on tasks other than driving. Furthermore, the vehicle could carry out hazardous missions on its own, like forward reconnaissance.

On the civilian side, Safran Tech has teamed up with PSA and Valeo for the last two years on autonomous automobile development. Their aim is to develop tomorrow's cars, starting with autonomous vehicles capable of operating in closed spaces on a predetermined path. In the words of Stéphane Cueille, Safran Senior Executive Vice President, R&T and Innovation, *"The development of an autonomous vehicle is a real strategic objective, one that demands expertise in technologies ranging from sensors and artificial intelligence to data and image processing. It also shares certain requirements with aerospace, such as guaranteed quality, system robustness and safety. Because of our technological expertise and proven skills in these areas, we are particularly well positioned to seize any new opportunities offered by autonomous operation in aerospace and defense, our core businesses."*

With the development of VTOL (vertical takeoff and landing) drones, which could become tomorrow's taxis, the entire urban landscape may take on a new look. In a few short years, we will no longer face technological barriers, but rather our human limits: would you be willing to ride in a driverless car? ■

**2019**

Patroller drone delivered to French Ministry of Defense.

**2020**

Production of Peugeot's first semi-autonomous cars in France.

**80%–20%**

Safran Engineering Services is developing for Peugeot a system comprising 80% sensors and 20% artificial intelligence.

## SAFRAN CORPORATE VENTURES

Our venture capital investment arm, Safran Corporate Ventures, was founded in 2015 to invest in European, American and Israeli startups in areas such as Industry 4.0, onboard equipment, autonomous operation, artificial intelligence, etc. It has already invested in eight companies, including Kronosafe and Kalray, two French startups working on autonomous operation.

## DRIVE FOR YOUALL CHAIR

Since 2014, Safran has financed the “Drive for YouAll” research chair, along with Valeo and PSA. The aim is to accelerate the development of autonomous and connected vehicle operation. The chair is overseen by the Mines ParisTech engineering school, in conjunction with the Ecole Polytechnique of Lausanne, University of California, Berkeley and Jiao-Tong University in Shanghai.

DIGITAL TRANSFORMATION

# Philippe GALAN

**Chief Digital Officer, Safran Helicopter Engines**

Digital transformation drives corporate transformation, while capitalizing on data acquisition and enhancing efficiency. Philippe Galan, Chief Digital Officer of Safran Helicopter Engines, shares his insights on the digital technologies being deployed.

**What technologies can we count on to advance the digital revolution?**

**P.G.:** Automation, connected production systems, robotics, virtual and augmented reality, etc. New technologies will boost the performance of our processes. We increase flexibility, while reducing production cycles and poor quality costs. These digital tools are used as decision aids, but people are still at the heart of our processes, since they have the experience and will continue to make decisions. For example, we are using augmented reality to aid the assembly process. It allows us to provide timely information that facilitates the work of fitters. Companies that deploy digital do it at all levels and for all processes. In other words, digital improvement also depends on a new approach to customer relations, dubbed Services 4.0.

**Do these tools generate value for our stakeholders?**

**P.G.:** We have a very clear objective: deliver our expertise to 2,500 customers worldwide. To achieve that goal we are deploying simple and personalized solutions, accessible anytime and anywhere, on all digital devices. That also means personalized access to websites, providing a customer dashboard, online documentation, etc. Over the last few months, the company launched a video assistance service called Expert Link, something like a secure FaceTime to remotely guide customers in their maintenance tasks, as well as a health monitoring service enabling them to track their engine's readings and set up preventive maintenance measures to limit the occurrence of unscheduled events. We control everything from design to repair of our helicopter engines. That proves our expertise and also enables us to anticipate customer requirements, developing proactive solutions by capitalizing on data. In fact, Safran Helicopter Engines

**"The company has to be connected to its times. The digital transformation is fostering a veritable data culture in companies, which entails an in-depth revamp of the internal and external environment."**

**3**
major deployment objectives for the digital transformation.

**1**
improvement in the user experience for our employees.

**4.0**
Industry 4.0.

has a very large store of information, generated by data from our own products and production systems, or based on data from our partners, customers and suppliers. We now want to digitize our processes to harvest even more data and, in the final analysis, improve our products while also creating new services.

**Does this digital revolution also concern company employees?**

**P.G.:** Yes, of course! To make sure our approach covers all bases, we also deploy different technical solutions for our employees via a project called "My Digital Life". Everything is being improved, including our network, WiFi, the cloud, videoconferences, data sharing within the company and externally, etc. The overall aim is to improve the customer experience and reduce the gap that sometimes exists between our lives at home and on the job. We are adapting to new ways of working, in particular to attract top new talent. Which means the company has to be welcoming, and that includes presenting a digital face. We have to be up to date! At Safran Helicopter Engines, we are therefore focusing our efforts in this domain via the IT department, which embodies the company's digital transformation, and will soon be strengthened by the addition of new skills in these technologies. That will subsequently lead to changes in our functions and disruption in how we work throughout the company. ■

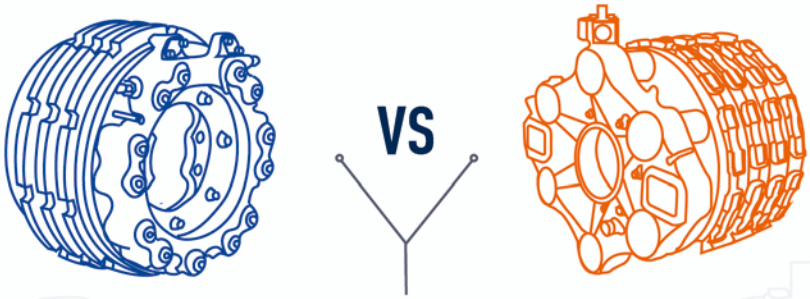
# CARBON BRAKES, 4 DECADES OF UNSTOPPABLE INNOVATION

Safran Landing Systems is today's global leader in carbon brakes, having outfitted more than 9,000 aircraft. Why have carbon brakes replaced their steel predecessors? How can they be produced in volume to support the fast-paced growth of air transport? The history and outlook of a future-looking growth technology.

While propeller planes generally didn't need powerful brakes because of their limited speed, the introduction of jet engine made brakes an integral part of flight safety. Today's regulations require an aircraft having to abort its takeoff roll at more than 300 km/h (186 mph), known as a rejected takeoff, or RTO, to be able to stop before running out of runway! The result is considerable energy generated in the form of heat, concentrated on the brakes. On an Airbus A320, for instance, the brake surface can reach a temperature of 2,500°C! Since conventional steel brakes were unable to keep pace with changing market requirements (higher and higher speeds, a search for weight savings, etc.), back in the 1970s Safran Landing Systems was already looking for alternative solutions. In 1977, the company selected a carbon-carbon composite material that was used at the time on rocket engines. Adapted to aircraft brake disks and dubbed SepCarb, it offered greater endurance, higher heat absorption capacity and significant weight savings (about 600 kilos/1,320 lb on an A320). After first being applied to a military aircraft in 1982, the Mirage 2000 fighter, SepCarb carbon brakes were then certified on the A300 and A310 commercial jetliners in 1985. Since then, they have gradually become the leaders in the commercial airplane market. The performance of carbon brakes has also been improved over the years, thanks to a sustained focus on innovation. The latest-generation SepCarb IV material, patented in 2009, represents a further advance. By adding more ceramic filler, engineers increased endurance while barely changing the weight. This meant that the brake could offer a longer service life, or it could be thinner, but still handle the same number of landings. The key advantage for airlines was to reduce operating costs on current fleets and save weight on their new airplanes. While the unrivaled performance of SepCarb IV ensures that Safran Landing Systems will maintain its world leadership in this market, it still has to meet another challenge, namely productivity. Workload forecasts in the aviation industry indicate a significant ramp-up in production volume over the next three years. Safran Landing Systems has therefore developed a manufacturing method that is the only one of its kind in the world: an impregnator-damper that groups two previously separate processes, impregnation and drying of parts. This method marks a decisive step forward in terms of production capacity, quality and working conditions. It was also a double award winner in the 2018 Safran Innovation Awards, taking both the Patented Technology and Grand Prize awards. Today, this process is already up and running at the Villeurbanne plant (near Lyon) and will soon be deployed at two other production facilities. ■

# FROM STEEL TO CARBON BRAKES

## A DISRUPTIVE TECHNOLOGY




**Endurance** — 3x

Energy **absorption** capacity — 3x

Number of aircraft **outfitted** — 9,000*+

**Landings per overhaul** (LPO) — 2,500

**Weight** — Cut in half

**Airbus and Boeing jetliners*

## DID YOU KNOW?

**Safran Landing Systems is also a supplier for F1 race cars**

- **Leading supplier of carbon** brake disks
- Supplies brakes to **9 teams**
- Also supplies carbon brake disks for **Formule E** electric race cars

Source: Safran

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